

SURVEY REPORT

How Sustainable Are Our Mobile Networks?

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Executive Summary

Sustainability and the impact of energy consumption on the climate are becoming urgent issues for the wireless industry. To assess how energy considerations will affect mobile networks and whether emerging technologies can help to minimise the industry's energy footprint, Mobile World Live conducted an international online survey of mobile industry professionals.

The results show that most companies in the mobile industry are serious about setting energy reduction targets, but the continued growth in data traffic and subscribers is likely to mean that energy consumption will become a limiting factor in network deployments in the near future. The survey also indicates that the industry is generally positive about the potential for network virtualization and the use of artificial intelligence (AI) and machine learning (ML) to help reduce energy consumption, but much less certain about the energy impact of edge deployments.



Key Findings

- **Majority of companies in the mobile industry have made quantifiable commitments to energy reduction targets**, led by European companies showing the most commitment. Reducing energy consumption is one of the industry's top three priorities today and in the next five years.
- **Energy consumption is expected to be an increasingly limiting factor in mobile network deployments in the next five years.** Respondents point to growing environmental awareness as well as practical issues, such as the high costs of clean energy and buildouts in non-grid areas.
- **Cost savings is universally considered the biggest driver for reducing energy consumption**, more so than social responsibility, regulatory compliance, or customer demand.
- **Mobile Internet data traffic and subscriber growth and the deployment of edge data centres** will drive the highest increases in energy consumption. In China, respondents also cited growth in Internet of Things (IoT) connections.
- **The radio access network (RAN) is the greatest guzzler of energy** and is also where the most energy savings can be made.
- **Strong belief among European respondents that virtualized networks and increased use of AI and ML** will help to reduce energy consumption and future 5G standalone networks are expected to consume less energy.

Introduction

By 2025, there will be 1.2 billion more mobile Internet subscribers, bringing the world's total to 5 billion and a total of 24.6 billion IoT connections¹. By 2023, there will be 13.1 billion mobile connected devices and 16.2 billion wired/Wi-Fi connected devices². The increases in subscribers, devices, and video traffic are expected to generate higher levels of energy consumption in mobile networks. With sustainability and climate change-driven action on government and operator agendas in much of the world, the wireless industry is under pressure to reduce its overall energy consumption.

The European Union wants to reduce greenhouse gas emissions by 55% by 2030 and aims to be climate neutral by 2050, which is the long-term goal of the European Green Deal that strongly ties economic growth to sustainability. Supporting the Green Deal, the European Commission recently dedicated €1 billion to fund research and innovation projects that solve the climate crisis as part of the Horizon 2020 programme, which is the programme's largest research investment.

Industry groups, including the GSMA and European Telecommunication Network Operators (ETNO) association, are supportive of the EU's sustainability efforts. The industry has already made progress in reducing its energy footprint. From 2010 to 2018, data traffic increased by 1,100%, but carbon emissions reduced by 40% and electricity consumption increased by 10%, according to ETNO³.

Estimates and methodologies vary in the calculation of the ICT sector's energy consumption and carbon footprint. The GSMA reports the ICT sector contributes 1.4% of global carbon emissions and 4% of electricity use⁴, while the mobile sector alone contributes just 0.4% of greenhouse gas (GHG) emissions⁵. According to ABI Research⁶, the energy consumption of global cellular networks in 2020 is 19.8 million tonnes oil equivalent (Mtoe) per year and this is expected to increase to 51.3 Mtoe by 2030, which is the equivalent of the energy consumed by all households in Australia and the UK combined.

A 2017 study by Canada's McMaster University found that, if unchecked, the ICT sector could

contribute 14% of GHG emissions by 2040, which would represent more than half of the transportation sector's emissions⁷. Energy consultancy Enerdata finds that the ICT sector accounts for between 5% and 9% of the world's energy consumption and could increase to 20% by 2030⁸, noting that the estimate does not take account of energy efficiency developments.

In early 2020, the International Telecommunication Union (ITU) published a new recommended standard for science-based targets to help ICT companies reduce GHG emissions by 45% between 2020 and 2030, which is required to comply with the United Nation's Paris Agreement. The GSMA notes that 29 operators accounting for 30% of global mobile connections have committed to science-based targets.

This MWL survey on behalf of InterDigital offers insight specifically for the mobile sector on the urgency to address energy consumption and how energy considerations could affect future network deployments. The survey also reveals current views on new technology developments that are likely to mitigate the impact of energy consumption on the climate.

¹GSMA, The Mobile Economy 2020

²Cisco Annual Internet Report

³ETNO Position Paper, https://etno.eu/downloads/positionpapers/etno%20position%20paper_2030%20climate%20targets%20ec%20public%20consultation.pdf

⁴GSMA, Climate FAQs

⁵GSMA, Position Paper on the European Green Deal

⁶ABI Research, Environmentally Sustainable 5G Deployment, https://www.interdigital.com/white_papers/environmentally-sustainable-5g-deployment

⁷Journal of Cleaner Production, <http://www.electronicssilent.springer.com/wp-content/uploads/2015/02/ICT-Global-Emissions-Footprint-Online-version.pdf>

⁸Enerdata, <https://www.enerdata.net/publications/executive-briefing/world-energy-consumption-from-digitalization.pdf>



Survey Methodology

This report is based on responses from an online survey of 168 mobile industry professionals conducted by Mobile World Live on behalf of InterDigital.

The respondent group comprises people from across the mobile industry, with the following breakdown: 23% are from network operators, 20% are from network equipment suppliers, 11% from

software vendors, 9% from systems integrators, 8% device manufacturers, 2% mobile virtual network operators (MVNOs), and 26% are classified as “other”. The other category includes a variety of mobile industry professionals in areas such as site acquisition, RAN optimisation, IoT solutions, testing, components, SIM card technology, finance, and consultancy.

Geographically, the largest group of respondents are from companies with headquarters in Europe (49%), followed by North America (20%), Asia (12%), China (8%), Africa (5%), South America (4%), and the Middle East (2%).



Perceptions and progress on reducing energy

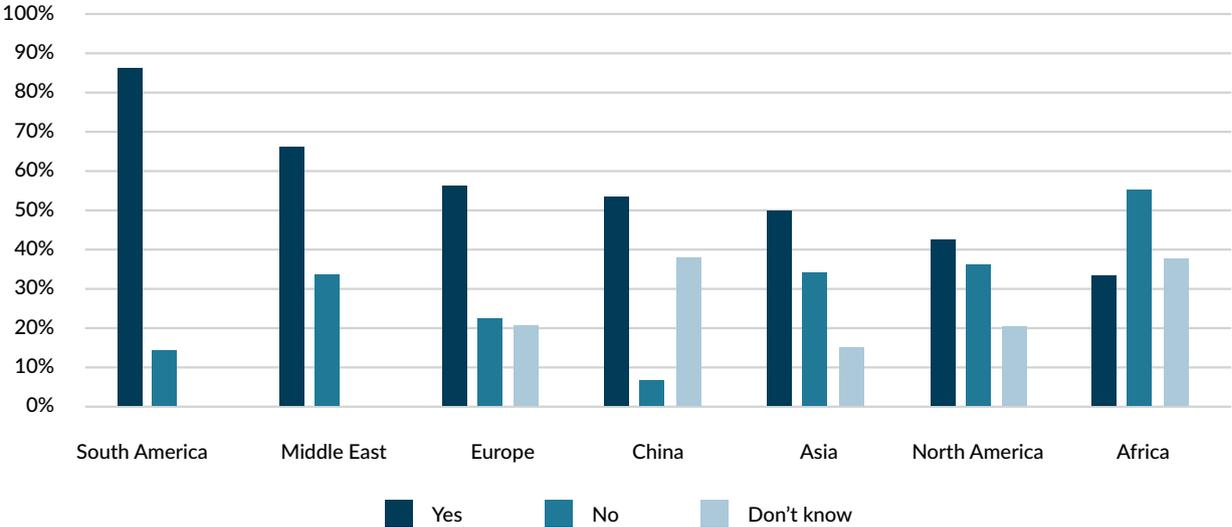
An overwhelming majority of respondents say that energy consumption is a priority issue for their companies and reveal that most companies already have set meaningful targets for energy reduction. The survey shows that 86% of respondents consider energy consumption to be a very important high priority or important medium priority in the products and services their company provides.

More than half of respondents (53%) across all geographies say that their companies have made quantifiable, public commitments to reducing energy consumption to investors, regulators, customers, or other stakeholders.

There are varying degrees of commitment in different geographies. Among European respondents, 57% say their

companies have made meaningful commitments, while 85% of South American respondents report their companies have made commitments. In China, 54% have committed to energy reduction, 50% in Asia, and just 42% in North America (Figure 1).

Figure 1. Has your company made quantifiable, public commitments for reducing energy consumption?



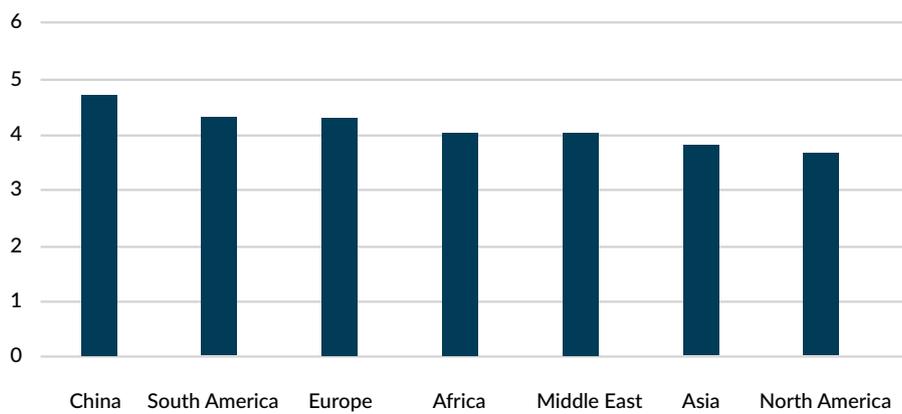
Respondents were asked to rate their company's efforts in reducing energy consumption. On a scale of 1 to 6 (where 1 is very poor and 6 is extremely good), the average rating was 4.1, which shows there is room for improvement and suggests that companies in the mobile industry are not doing enough to be more energy efficient. The largest

proportion of respondents (30%) gave their company a rating of 5, while 23% rated their company's efforts a 4, and 20% gave their company a rating of 3.

Companies in some regions are performing better than others. In China, South America and Europe, companies received the highest

marks for their energy reduction efforts (Figure 2). On average, respondents from China gave their companies the highest rating (4.69 average score), followed by South America and Europe with average scores of 4.29 and 4.27, respectively. North American companies were rated the worst with an average score of 3.64.

Figure 2. Rate your company's efforts in reducing energy consumption on a scale of 1 to 6 (where 1 is very poor and 6 is extremely good).



By far the biggest motivating factor for the mobile industry to consume less energy is cost savings (Figure 3). More than half (56%) of respondents say cost savings are the main driver for reducing energy consumption. Most respondents are motivated by cost reduction rather than social responsibility, regulatory compliance, or customer demand. Notably, meeting regulatory requirements emerged as one of the least important factors, as only 10% of respondents across all geographies consider it to be a main driver.

A closer look at responses from different parts of the world confirms that cost savings is overwhelmingly the main driver globally.

Cost savings is rated the top driver by 79% of respondents from Asia, 60% of European respondents, 52% of North American respondents, and 36% of respondents from China. Interestingly, more North

American respondents (30%) cited social responsibility as the main driver than European respondents (25%) and Chinese respondents (27%).

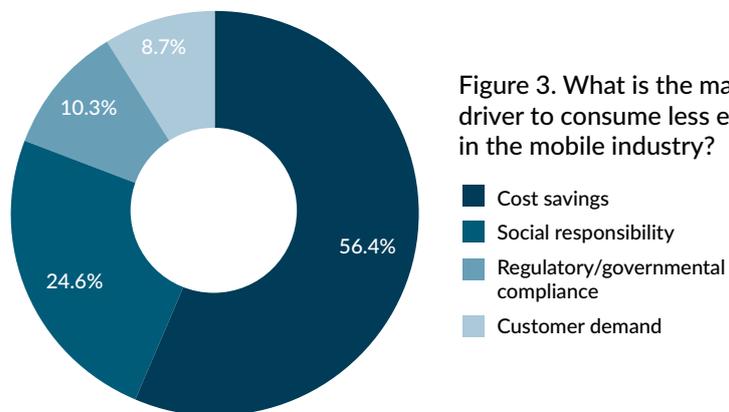


Figure 3. What is the main driver to consume less energy in the mobile industry?

To understand how energy efficiency is perceived in the context of broader mobile industry goals, respondents were asked to rank the industry's priorities today and what they will be in the next five years. The survey shows that while reducing energy use is not the highest priority, it is among the top

three most important and it will take on greater importance in the next five years. The highest rated priorities today are increasing capacity to support growing amounts of data and video traffic and improving network performance, while reducing energy consumption is ranked in distant

third place (Figure 4). In the next five years, the results suggest that efforts to reduce energy will be more important, as 56% of respondents ranked this as one of the industry's top three priorities compared to just 44% who ranked it in the top three today (Figure 5).

Figure 4. Most important priorities for the mobile industry today [ranked in order of importance]

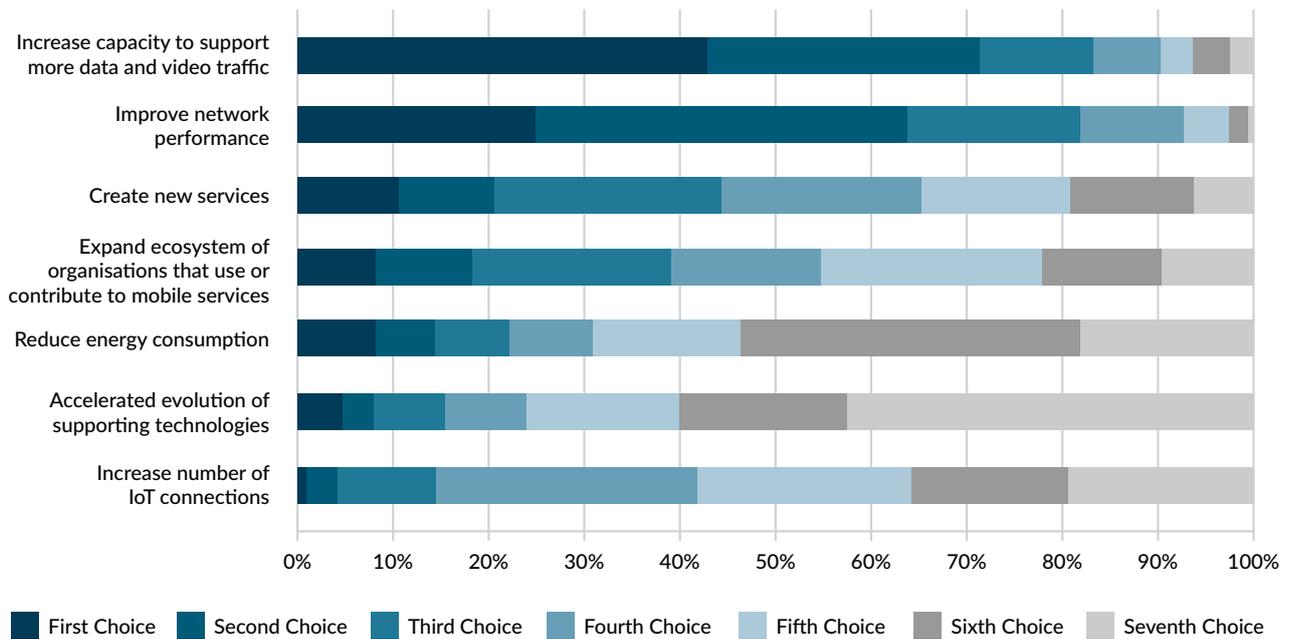
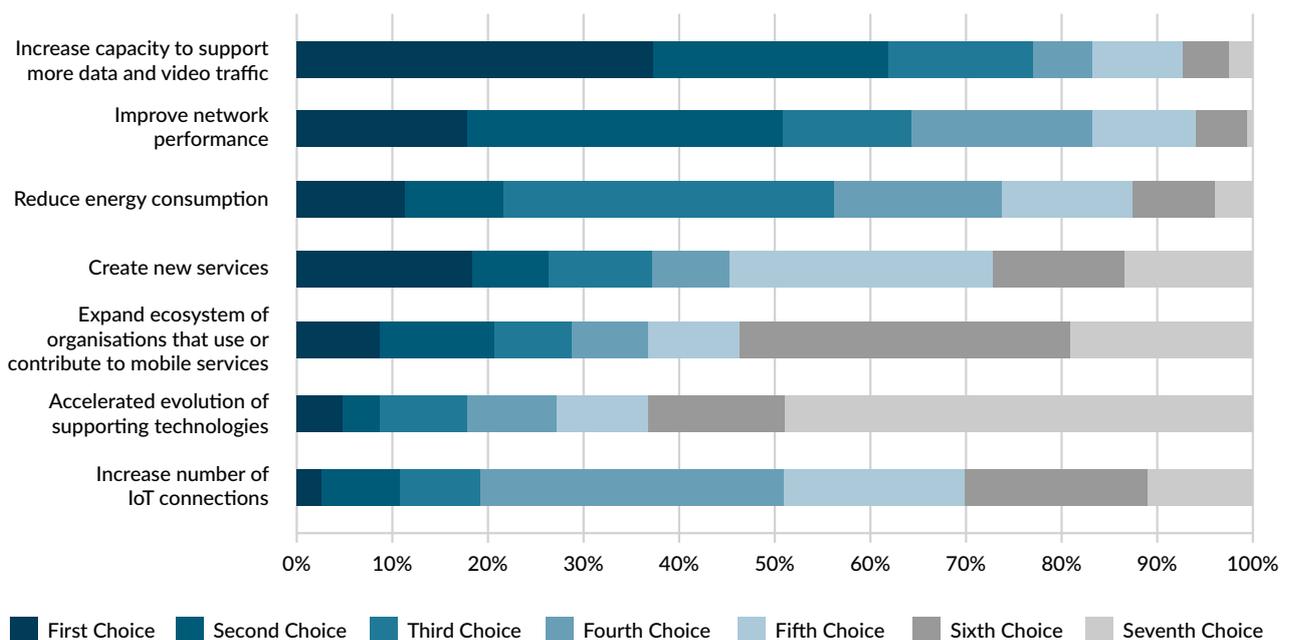


Figure 5. Most important priorities for the mobile industry in the next 5 years [ranked in order of importance]





Assessing the impact of energy consumption in mobile networks

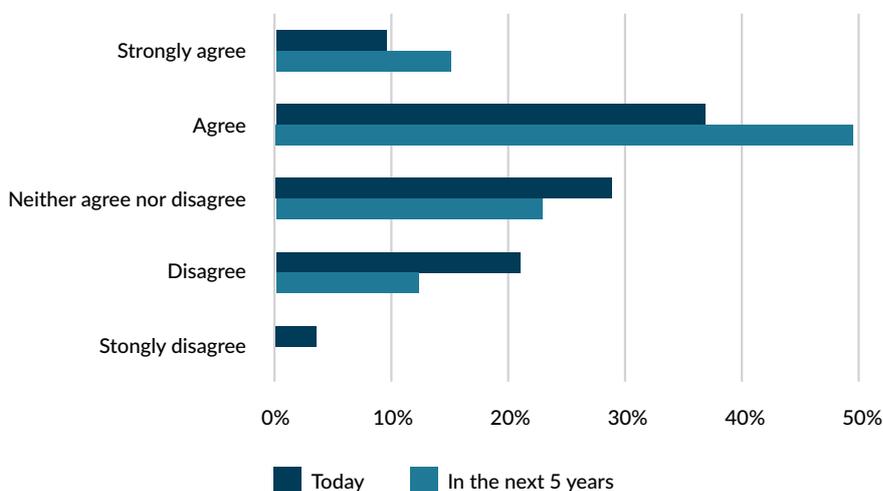
The overall view of respondents is that as energy consumption increases, it will become a limiting factor in mobile network deployments (**Figure 6**). Today, 46% of respondents agree or strongly agree that energy consumption is a limiting factor. This view is consistent across different geographies as there is little variation in the results: 46% of European respondents agree or strongly agree it is a limiting factor today, 44% of respondents from North America agree or strongly agree, and half of respondents from Asia and China also agree or strongly agree.

The survey suggests that energy consumption will be a much bigger issue in the future, as 65% of all respondents agree or strongly agree that it will be a limiting factor in mobile network deployments in the next five years. Geographically, there appears to be greater concern about the potential impact of

energy consumption among respondents from China and North America. In China, 78% of respondents agree or strongly agree that energy use will be a limiting factor, while 73% of respondents from North America say it will be a limiting factor. In Europe, 61% agree or strongly agree it will be limiting, and the remaining 39% disagree or are indifferent.

Respondents were asked to provide a brief explanation for why energy considerations could limit mobile network deployments. Answers included “changing political environments,” “increasing awareness,” “cost of clean energy,” “shift to green energy takes time,” and “non-grid areas will need very efficient build out.”

Figure 6. Energy consumption is a limiting factor in mobile network deployments





When it comes to determining which part of the mobile ecosystem consumes the most energy, more than half (53%) of respondents across all geographies (except China) point to the radio access network (RAN) (Figure 7). The RAN is also where the biggest energy savings can be made, according to the largest proportion of respondents (45%). After the RAN, 17% say cloud application servers consume the most energy, 13% say it is the core network, while 12% say it is devices, including smartphones and IoT. Only 5% of respondents say that backhaul and transport networks consume the most energy.

Interestingly, Chinese respondents have a different view on what uses the most energy. The largest

proportion of respondents from China (40%) say that devices not only consume the most energy but are also where the most energy savings can be achieved. The difference in perception could be partly due to the makeup of the

group of survey participants from China. Nearly half of respondents from China are from device manufacturers, which is a far higher proportion compared to the overall respondent group that has just 8% from device manufacturers.

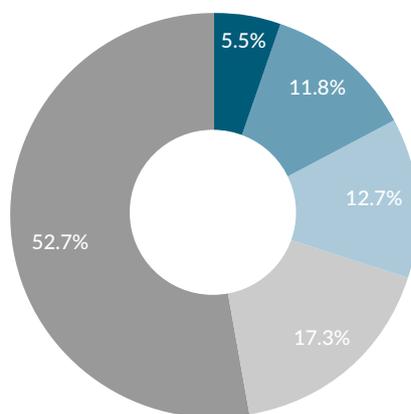


Figure 7. Which part of the mobile infrastructure ecosystem consumes the most energy?

- AI/ML computing implementations
- Backhaul and transport
- Devices (smartphones, IoT)
- Core network
- Cloud application servers
- Radio access network

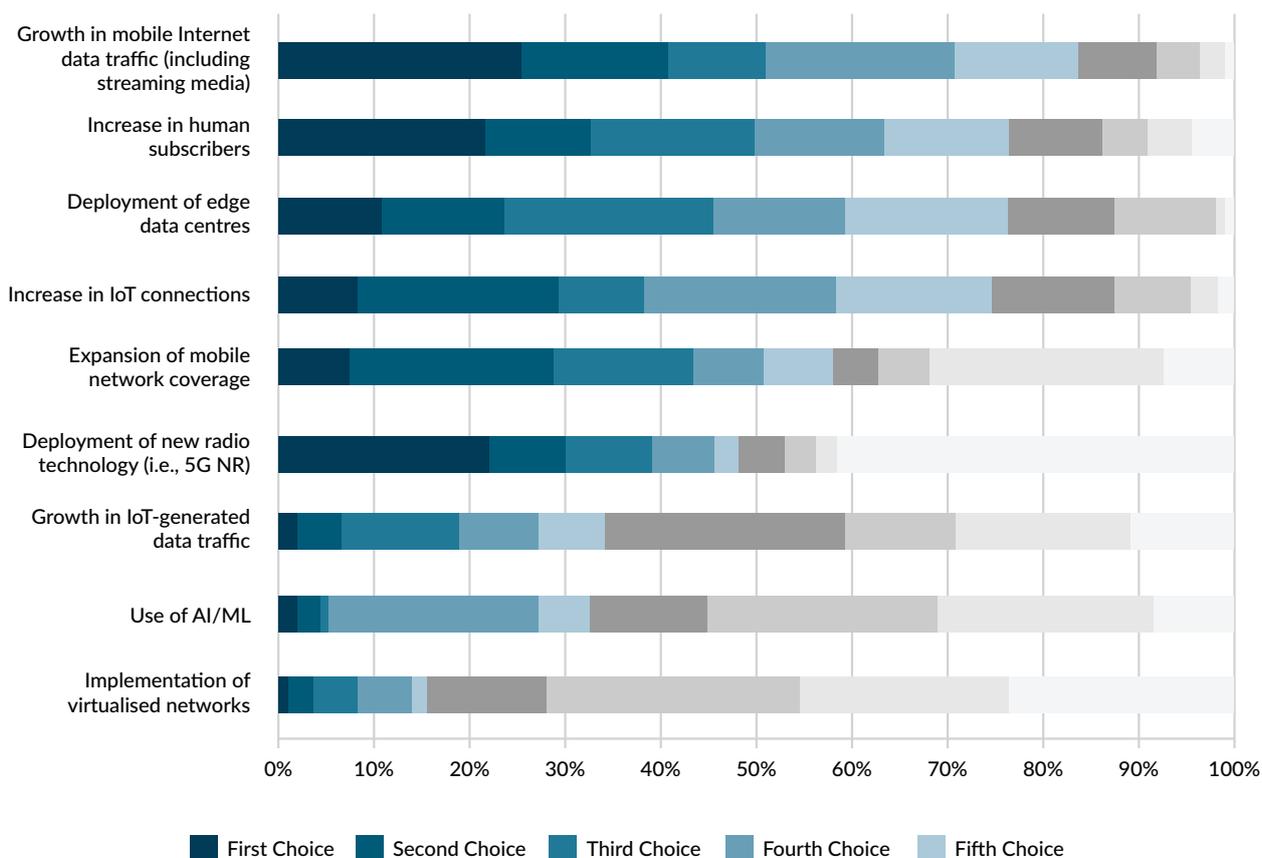
The survey shows, perhaps not surprisingly, that the primary culprits that will cause the highest increases in energy consumption in mobile networks are the growth in mobile data traffic (including streaming video) and growth in mobile subscribers (Figure 8). Respondents also highly ranked the

deployment of edge data centres and growth in IoT connections as drivers of higher energy use.

Geographically, there were some differences in how respondents ranked these drivers. In North America, the top three choices were growth in subscribers, IoT

connections, and data traffic, compared to respondents from Asia who cited data traffic and subscriber growth as well as mobile network coverage expansion. In China, respondents' top choices were growth in data traffic and IoT connections along with deployment of edge data centres.

Figure 8. Drivers of energy consumption increases in mobile networks [ranked in order from highest energy increase to lowest]



Network evolution and the implications for energy consumption

As mobile networks evolve, new technologies and developments will directly or indirectly affect energy consumption. Some will contribute reducing energy use and others will only consume more energy, and some of course will do both. This survey does not attempt to determine the net energy impact of specific technologies, but rather, seeks industry insight into the likely impact. In other words, which technology developments will be part of the solution and which will be part of the problem for energy consumption?

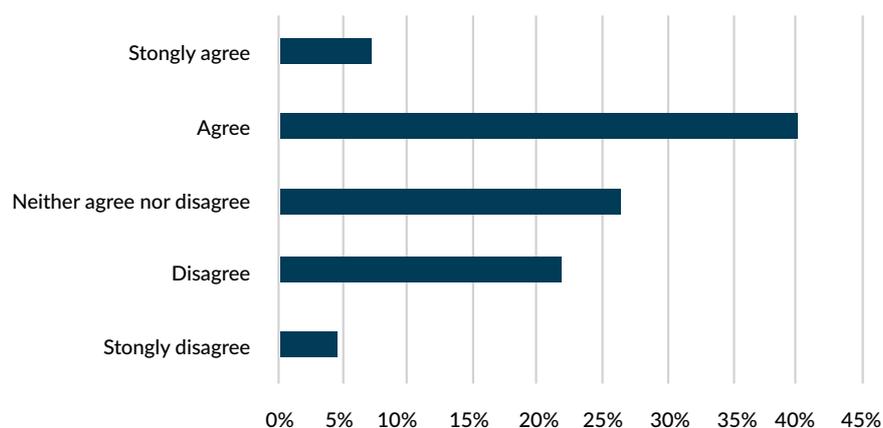
Specifically, the respondents were asked to assess the impact of the following: increased use of AI/ML; virtualisation; edge deployments; 5G standalone networks; IoT connections; and the expansion of network coverage.

Not surprisingly, respondents for the most part (66%) do not think expanding mobile network coverage will contribute to lower energy consumption. Only 12% agree that adding more coverage will result in less energy consumption in mobile networks.

Respondents generally appear hopeful that AI and ML will have a positive effect on mobile network energy consumption (**Figure 9**). Nearly half of respondents (49%) agree or strongly agree that using more AI and ML will lead to reducing energy use. However, 26% remain neutral without agreeing or disagreeing and 22% disagree.

Geographically, European respondents show the strongest support for the positive impact AI/ML will have on mobile networks as 57% agree or strongly agree that it will reduce energy consumption. In China and South America, 40% agree or strongly agree and 38% of respondents in Asia agree or strongly agree. However, in North America, respondents are for the most part ambivalent with a nearly even spread among those who agree (32%), are undecided (32%), and disagree (36%), although slightly more disagree.

Figure 9. Increased use of AI/ML will reduce energy consumption in mobile networks

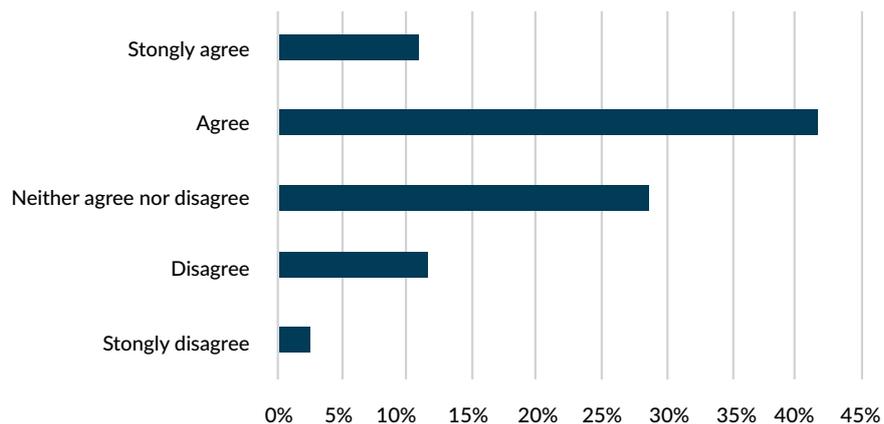


Considering virtualized networks, most respondents (55%) agree or strongly agree that virtualized networks will reduce energy consumption in mobile networks. However, nearly one third of respondents (29%) are uncertain,

suggesting there is possibly a need for more understanding and education in virtualization technologies (Figure 10). Looking at the results without the undecided responses (neither agree nor disagree), then the support for

virtualized networks making a positive contribution to energy use in mobile networks is overwhelming, with 78% saying that they will reduce energy consumption.

Figure 10. Virtualized networks will reduce energy consumption in mobile networks



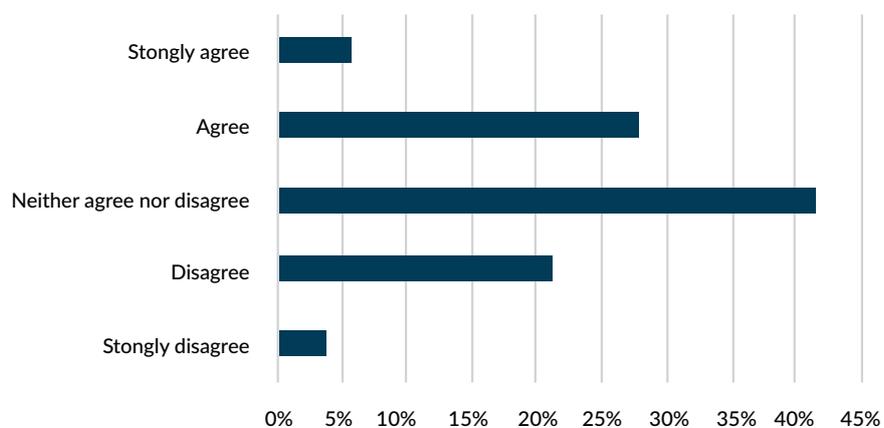
The impact of edge deployments is not clear based on the survey results. The largest proportion of respondents (41%) did not take a position on whether edge deployments will reduce or increase energy consumption, opting to neither agree nor disagree. Just

over a third of respondents (34%) agree or strongly agree that deploying edge data centres will reduce energy, while 25% disagree or strongly disagree (Figure 11).

These results were broadly reflected across geographies except

for North America, where respondents had stronger opinions. In North America, 41% agree or strongly agree that edge deployments will decrease energy consumption, 32% disagree or strongly disagree, while only 27% are neutral.

Figure 11. Edge deployments will reduce energy consumption in mobile networks

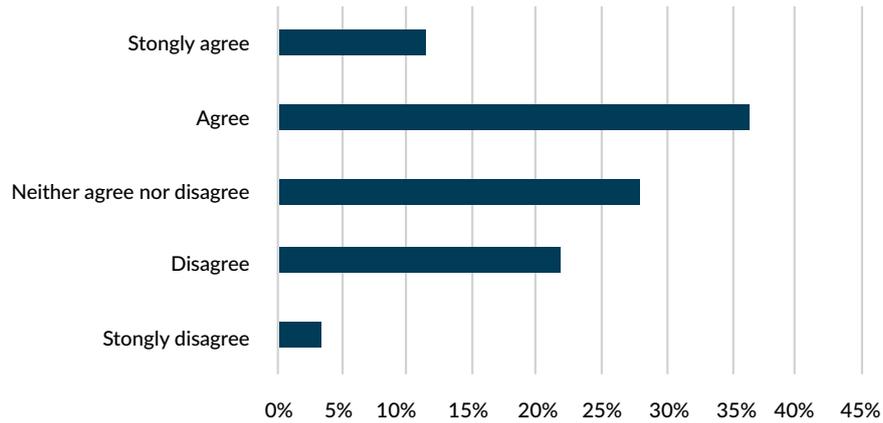


Future 5G networks – i.e., 5G standalone (SA) deployments – are expected to consume less energy than early, non-standalone 5G networks. Nearly half of respondents agree or strongly

agree (47%) that 5G SA will consume less energy. But almost a third of respondents (28%) are undecided and 25% disagree or strongly disagree (Figure 12).

Fewer respondents in North America agree or strongly agree (36%) that 5G SA will consume less energy and more disagree or strongly disagree (36%), compared to the full survey data set.

Figure 12. Future 5G networks will consume less energy than 5G networks today



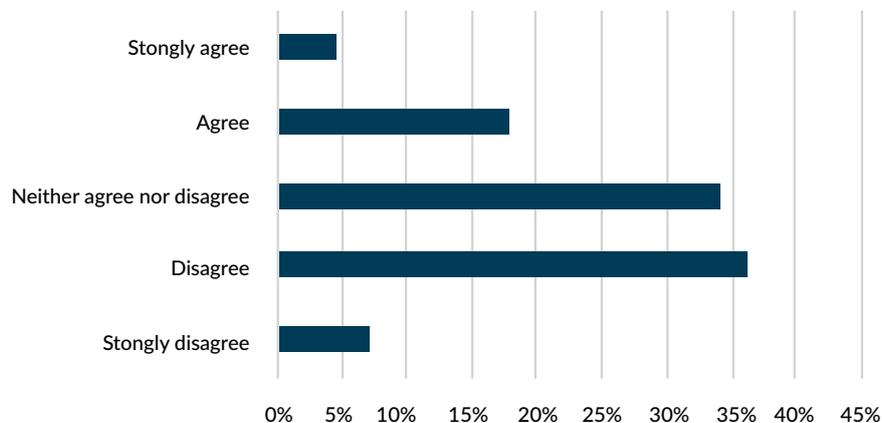
Growth in IoT connections is not likely to result in lower energy consumption in mobile networks, according to the survey results. The largest proportion of respondents (43%) disagree or strongly disagree that the proliferation of IoT connections will result in a net reduction in energy consumption in

mobile networks, while 35% neither agree nor disagree and 23% agree or strongly agree (Figure 13).

consumption and just 9% agree or strongly agree. In China, 40% of respondents agree and 40% disagree or strongly disagree. In Europe, more respondents are undecided about the impact as 43% neither agree nor disagree.

There were some variations in the geographic results. In North America, 55% of respondents disagree or strongly disagree that more IoT connections will result in less energy

Figure 13. Proliferation in IoT connections will result in a net energy reduction in energy consumption in mobile networks



Conclusion

The survey shows that energy consumption is one of the top priorities for the mobile industry today and that it will become even more important in the next five years, as the majority of respondents believe it will be a limiting factor in the deployment of mobile networks.

Efforts to reduce energy consumption are universally motivated by cost savings. As operators expand and upgrade networks to support increases in subscribers, devices, and video traffic, energy savings are likely viewed as essential for achieving sustainable growth.

The pace of progress varies across geographies. European companies lead the industry in their commitment to energy reduction targets. But North American companies received the lowest scores on efforts to decrease their energy use.

The results suggest that the industry looks forward to future 5G SA networks to consume less energy and is generally positive on the potential for virtualized networks and AI/ML to help reduce energy consumption in mobile networks. The view from Europe is most favourable regarding the impact of AI/ML. But sizable proportions of respondents were undecided in their energy assessments of new technology developments, especially edge deployments. The uncertainty revealed by the survey suggests there is an opportunity for further education in the market as well as for more in-depth study in future.



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